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(54) STOCK FOR APERTURE GRILL FOR COLOR PICTURE TUBE, ITS PRODUCTION, APERTURE GRILL AND PICTURE TUBE

(57) Abstract:

PROBLEM TO BE SOLVED: To obtain the stock for an aperture grill for a color picture tube having excellent tensile strength and high temp. creep strength and furthermore having excellent magnetic properties as a magnetic shielding material by incorporating a low carbon steel sheet with specified amounts of Cu and P.

SOLUTION: A low carbon steel sheet contg., by weight, 0.05 to 2.5% Cu and furthermore contg., at need, 0.01 to 0.4% P is used as the stock to obtain an aperture grill for a color picture tube. As the low carbon steel sheet, an extra-low carbon steel having a compsn contg., by weight, $\leq 0.01\%$ C, about $\leq 0.5\%$ Mn about $\leq 0.05\%$ Si and prescribed amounts of Cu and P, and in which the contents of carbide and nitride are reduced by vacuum degassing is preferably used. The low carbon steel sheet as the stock is obtd. by subjecting a hot rolled steel strip obtd. by executing hot rolling and pickling to low carbon steel having the above compsn. to cold rolling, subjecting it to process annealing and secondary cold rolling at 500 to 600°C according to necessary and thereafter executing aging treatment at 300 to 700°C.

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CLAIMS

[Claim(s)]

[Claim 1]A raw material for aperture grills for color picture tubes which consists of a low carbon steel plate which contains Cu 0.05 to 2.5weight %.

[Claim 2]A raw material for aperture grills for color picture tubes which consists Cu of a low carbon steel plate contained 0.001 to 0.4weight % in 0.05 to 2.5 weight %, and P.

[Claim 3]A manufacturing method of a raw material for aperture grills for color picture tubes which carries out aging treatment at temperature of 300-700 **, and is characterized by things after cold-rolling a low carbon hot-rolled steel strip in coil which contains Cu 0.05 to 2.5weight %.

[Claim 4]A manufacturing method of a raw material for aperture grills for color picture tubes which carries out aging treatment at temperature of 300-700 **, and is characterized by things after cold-rolling a low carbon hot-rolled steel strip in coil which contains 0.05 to 2.5 weight %, and P for Cu 0.001 to 0.4weight %.

[Claim 5]A manufacturing method of a raw material for aperture grills for color picture tubes which cold-rolls a low carbon hot-rolled steel strip in coil which contains Cu 0.05 to 2.5weight %, cold-rolls secondarily after giving intermediate annealing at temperature of 500-800 ** subsequently, carries out aging treatment at temperature of 300-700 ** after that, and is characterized by things.

[Claim 6]A low carbon hot-rolled steel strip in coil which contains 0.05 to 2.5 weight % and P for Cu 0.001 to 0.4weight % is cold-rolled. Subsequently, a manufacturing method of a raw material for aperture grills for color picture tubes which cold-rolls secondarily after giving intermediate annealing at temperature of 500-800 **, carries out aging treatment at temperature of 300-700 ** after that, and is characterized by things.

[Claim 7]An aperture grill for color picture tubes which consists of a low carbon steel plate which contains Cu 0.05 to 2.5weight %.

[Claim 8]An aperture grill for color picture tubes which consists Cu of a low carbon steel plate contained 0.001 to 0.4weight % in 0.05 to 2.5 weight %, and P.

[Claim 9]A color picture tube incorporating an aperture grill for color picture tubes which consists of a low carbon steel plate which contains Cu 0.05 to 2.5weight %.

[Claim 10]A color picture tube incorporating an aperture grill for color picture tubes which consists Cu of a low carbon steel plate contained 0.001 to 0.4weight % in 0.05 to 2.5 weight %, and P.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the color picture tube incorporating the raw material for aperture grills for color picture tubes, its manufacturing method, an aperture grill, and it. While having the tensile strength and high temperature creep strength which were more excellent in details, it is related with the color picture tube incorporating the raw material for aperture grills for color picture tubes which has outstanding magnetic properties, its manufacturing method, an aperture grill, and it.

[0002]

[Problem to be solved by the invention] Since the aperture grill used for a color picture tube is welded to a frame where load of the big tension is carried out on the occasion of the manufacture, it is needed for the raw material for aperture grills for color picture tubes to have the tensile strength of 60 kgf/mm^2 at least. Therefore, the low carbon steel plate which performed strong processing and carried out processing strengthening as a raw material for aperture grills for color picture tubes used now is used.

[0003] Although heat treatment for [which carries out back melanism] having been welded to the frame is performed, in order to hold the state where load of the tension was carried out, without each tape which constitutes the aperture grill after melanism slackening, heat treatment is carried out in a short time for about 15 minutes at 455°C below the recrystallizing temperature of steel, however. In this melanism heat treatment condition, etholung is nonavoidable, stretch arises on a tape by recovery and the tape has become a cause which twists or goes out. For this reason, as a raw material for aperture grills for color picture tubes, That is [stretch does not arise in melanism heat treatment for $455^\circ\text{C} \times 15 \text{ minutes}$], the tensile strength more than 60 kgf(s)/mm^2 and the elongation at the time of carrying out load of the

tensile stress of 30 kgf/mm^2 . To have the creep strength which is 0.4% or less is needed.
 [0004]The color picture tube comprises a phosphor screen which changes an electron beam to an electron gun at an image, and in order to prevent an electron beam from geomagnetism deflecting, the inside of a television picture tube is covered with the magnetic shield material. The aperture grill also needs to have the operation as this magnetic shield material, the magnetic flux density (Br) as magnetic properties is large, and coercive force (Hc) is small searched for for material with a large ratio (Br/Hc) of magnetic flux density to coercive force. However, in the low carbon steel plate in which strong processing is performed in order to obtain yield strength high as mentioned above, and melanism heat treatment is also performed below with recrystallizing temperature, Magnetic flux density is as low as below eight kilogausses (kG), and coercive force is as large as about 5 oersteds (Oe), therefore Br(kG)/Hc (Oe) is as small as about 1.6, and inferior as a magnetic shield material.

[0005]Although methods of raising the tensile yield strength of a low carbon steel plate include the solid-solution-strengthening method by C, N, etc. conventionally, if C in steel and the quantity of N increase, carbide and a nitride will increase, movement of a magnetic domain wall comes to be barred, and magnetic properties deteriorate. Although methods of raising creep strength include the method of depositing carbide etc. in steel, Most of these sludges have large particle diameter at micron order, these block movement of a magnetic domain wall, and in order to degrade magnetic properties greatly, such a method is not applied as a manufacturing method of the raw material for the present aperture grills for color picture tubes. This invention makes it SUBJECT to provide a raw material for aperture grills for color picture tubes which has the magnetic properties superior to the present material, and a manufacturing method for the same while having the outstanding tensile strength and high temperature creep strength.

[0006]

[Means for solving problem]Invention of Claim 1 relates to the raw material for aperture grills for color picture tubes which consists of a low carbon steel plate which contains Cu 0.05 to 2.5weight %. Invention of Claim 2 relates Cu to the raw material for aperture grills for color picture tubes which consists of a low carbon steel plate contained 0.001 to 0.4weight % in 0.05 to 2.5 weight %, and P. After invention of Claim 3 cold-rolls the low carbon hot-rolled steel strip in coil which contains Cu 0.05 to 2.5weight %, aging treatment of it is carried out at the temperature of 300-700 **, and it is related with the manufacturing method of the raw material for aperture grills for color picture tubes characterized by things. After invention of Claim 4 cold-rolls the low carbon hot-rolled steel strip in coil which contains 0.05 to 2.5 weight %, and P for Cu 0.001 to 0.4weight %, aging treatment of it is carried out at the temperature of 300-700 **, and it is related with the manufacturing method of the raw material for aperture grills for color picture tubes characterized by things. Invention of Claim 5 cold-rolls the low carbon hot-

rolled steel strip in coil which contains Cu 0.05 to 2.5weight %, Subsequently, after giving intermediate annealing at the temperature of 500-800 **, it cold-rolls secondarily, and aging treatment is carried out at the temperature of 300-700 ** after that, and it is related with the manufacturing method of the raw material for aperture grills for color picture tubes characterized by things. Invention of Claim 6 cold-rolls the low carbon hot-rolled steel strip in coil which contains 0.05 to 2.5 weight %, and P for Cu 0.001 to 0.4weight %, Subsequently, after giving intermediate annealing at the temperature of 500-800 **, it cold-rolls secondarily, and aging treatment is carried out at the temperature of 300-700 ** after that, and it is related with the manufacturing method of the raw material for aperture grills for color picture tubes characterized by things. Invention of Claim 7 relates to the aperture grill which consists of a low carbon steel plate contained 0.05 to 2.5weight %, and Cu invention of Claim 8, Cu is related with the aperture grill which consists of a low carbon steel plate contained 0.001 to 0.4weight % in 0.05 to 2.5 weight %, and P. Invention of Claim 9 is a thing about the color picture tube incorporating the aperture grill for color picture tubes which consists of a low carbon steel plate which contains Cu 0.05 to 2.5weight %. Invention of Claim 10 relates to the color picture tube incorporating the aperture grill for color picture tubes which contains 0.05 to 2.5 weight %, and P for Cu 0.001 to 0.4weight %.

[0007]

[Mode for carrying out the invention]By depositing the detailed Cu phase (epsilon phase) of a NANOMETA (nm) order by aging treatment, or adding P further, and using solid solution strengthening of P together in this invention, in the extremely low carbon steel which added Cu, While securing the tensile strength more than 60 kgf(s)/mm^2 , it became clear that the magnetic properties which excelled [annealing / by aging treatment] in $\text{Br(kG)/Hc(Oe)} \geq 2.5$ were acquired.

[0008]Hereafter, this invention is explained in detail. Decarbonization and the thing which carried out denitridation treatment, decreased the carbide and the nitride in steel, and promoted grain growth at the process of hot-rolling or hot-rolling, and continuous annealing are preferred, using a vacuum degassing process as extremely low carbon steel used as a raw material of the aperture grill for the color picture tubes of this invention. Since the carbide and the nitride which are minutely distributed in steel bar movement of a magnetic domain wall and degrade magnetic properties, they need to limit beforehand the element contained in steel, and need to decrease these as much as possible. Limitation of the element which first is added by the steel used for the raw material of the aperture grill for the color picture tubes of this invention, and its addition is explained.

[0009]It becomes a cause by which carbide will increase if there are many amounts of C in the steel plate after cold rolling, movement of a magnetic domain wall is checked about C, and grain growth is barred, and magnetic properties deteriorate. Therefore, maximum of the

addition of C it limits to 0.01 weight %. A minimum is preferred as long as it can decrease practical by vacuum degassing treatment.

[0010] It is so desirable that there are few additions in order to raise magnetic properties, although Mn needs to fix as MnS which combines with S in steel and is contained in steel about Mn and it is necessary to add hot shortness to a ***** sake -- it is considered as 0.5 or less weight % of an addition.

[0011] Since Si degrades the adhesion of a blackening film, it is taken as 0.3 or less weight % of an addition. Little way of S is preferred from the field of grain growth -- 0.05 or less weight % of an addition is preferred. N also has being the same and 0.05 or less weight % of a preferred addition.

[0012] About Cu, the precipitation amount of epsilon phase in aging treatment increases, so that an addition increases, and yield strength and creep strength increase greatly. Since epsilon phase is a sludge with detailed nanometer order, the grade which barring movement of a magnetic domain wall does not almost have unlike the sludge of micron order, and degrades magnetic properties is very small. Therefore, yield strength and creep strength can be made to increase by increasing the addition of Cu, without reducing magnetic properties. However, the effect of intensity rise sufficient in the addition below 0.05 weight % is not acquired. On the other hand, since a sludge will become great and magnetic properties will deteriorate if there are too many additions, it is an addition. It is preferred that it is 2.5 or less weight %.

[0013] P is effective in raising intensity by solid solution strengthening, and since tensile strength and creep strength increase greatly by addition of P, in addition to strengthening based on a prescription deposit by Cu addition made into the purpose of an application concerned, it can use together solid solution strengthening by P. Although intensity sufficient with 0.001 weight % or more of an addition comes to be obtained, if an addition exceeds 0.4%, in order to be generated by mixed grain size by a segregation, it is considered as 0.4 or less weight % of an addition.

[0014] Next, a manufacturing method of steel sheets as a raw material for aperture grills for color picture tubes of this invention is explained. After hot-rolling extremely low carbon steel containing the above-mentioned chemical entity ingoted using vacuum melting or a vacuum degassing process, an oxide film which carried out pickling and was produced at a hot-rolled process is removed. Then, it cold-rolls and is considered as 0.035-0.2 mm of board thickness. Subsequently, aging treatment of 20 hours is performed from 10 minutes at temperature of 300-700 °C. When there are many additions of Cu, or Cu and P, since recrystallizing temperature rises, even if it carries out aging treatment near maximum 700 °C, it does not interfere, but it is preferred preferably to carry out aging treatment at temperature of 450-550 °C in consideration of a precipitation amount of Cu or particle diameter of a sludge. epsilon phase does not fully deposit that prescription temperature is less than 300 °C, and required tensile

strength is not obtained. On the other hand, if prescription is carried out at temperature over 700 °C, it will become overaging, and epsilon phase re-dissolves in steel, and tensile yield strength falls. By cooking temperature and cooking time, even if any of a cube type annealing furnace and a continuous annealing furnace are used for aging treatment, it does not interfere. [0015] Cold-roll by reaching and carrying out pickling of the above-mentioned extremely low carbon steel as another mode, and it is considered as 0.1-0.6 mm of board thickness. Subsequently, after carrying out intermediate annealing at the temperature of 500-800 °C and adjusting a crystal grain diameter, secondary cold rolling is performed, the last board thickness may be made into 0.035-0.2 mm of board thickness, and aging treatment of the account of Gokami may be performed. If one side and annealing temperature which it becomes insufficient softening, and will become extremely high in tensile strength if the above-mentioned aging treatment is performed after secondary cold-rolling exceed 800 °C when annealing temperature is less than 500 °C, even if it performs the above-mentioned aging treatment after secondary cold-rolling, desired tensile strength will not be obtained. [0016]

[Working example] Hereafter, an embodiment explains this invention still in detail. the slab which carried out vacuum degassing of nine kinds of steel (A-1) which has the chemical composition shown in Table 1, and ingoted it is hot-rolled -- it was considered as the hot-rolled board of 2.5 mm. It cold-rolled, after carrying out sulfuric acid pickling of these hot-rolled boards, and board thickness considered it as two kinds of cold-rolled boards which are 0.1 mm and 0.3 mm. Then, board thickness performs aging treatment directly about the cold-rolled board which is 0.1 mm, board thickness gives intermediate annealing about the cold-rolled board which is 0.3 mm, and board thickness Aging treatment was performed, after cold-rolling secondarily so that it may be set to 0.1 mm. Thus, magnetic flux density and coercive force were measured having applied the magnetic field of ten oersteds for the obtained test specimen using an Epstein style magnetic measurement device of a short form, and $B_r(kG)/H_c(Oe)$ was calculated. Creep strength measured the elongation (%) at the time of holding tensile strength at 455 °C in the atmosphere for 15 minutes using a creep tester (made in the Tokai factory), having applied load stress 30 kgf/mm^2 , and tensile estimated it. The characteristic of intermediate annealing and aging treatment conditions, and a test specimen is shown in Table 2.

[0017]

[Table 1]

供試材（鋼板）の化学組成

試料 番号	化 学 組 成 (重量%)							
	C	Mn	Si	S	N	Cu	P	Fe
A	0.036	0.47	0.01	0.01	0.002	0.03	0.153	残部
B	0.044	0.48	0.01	0.01	0.002	0.05	0.160	残部
C	0.046	0.45	0.01	0.01	0.002	1.60	0.0004	残部
D	0.067	0.47	0.01	0.01	0.002	1.61	0.001	残部
E	0.065	0.47	0.01	0.01	0.002	1.59	0.157	残部
F	0.065	0.46	0.01	0.01	0.002	1.63	0.397	残部
G	0.065	0.44	0.02	0.01	0.002	1.62	0.423	残部
H	0.065	0.47	0.01	0.01	0.002	2.47	0.159	残部
I	0.067	0.47	0.01	0.01	0.002	2.51	0.162	残部

[0018]

[Table 2]

呼吸器用および中間焼鈍条件と母材の特性

試験 番号	中間焼鈍条件		焼鈍処理条件		Rr/Rc (xG/Gc)	降伏強度 (kgf/mm ²)	クリーブ 伸び (%)	区 分
	温度(°C)	時間(分)	温度(°C)	時間(分)				
A	—	—	450	400	2.3	89	9.30	比較例
B	—	—	450	400	2.5	82	9.25	本発明
C	—	—	450	400	2.4	75	9.05	本発明
D	—	—	450	400	3.2	77	9.05	本発明
E 1	—	—	250	1500	1.4	91	9.99	比較例
E 2	—	—	300	1200	2.6	84	0.29	本発明
E 3	—	—	500	250	3.7	76	0.01	本発明
E 4	—	—	700	10	4.3	85	0.06	本発明
E 5	—	—	750	8	8.0	64	0.89	比較例
F	—	—	450	400	2.3	38	0.04	本発明
G	—	—	500	400	2.0	90	0.03	比較例
H 1	450	800	450	400	2.3	87	0.06	比較例
H 2	500	500	450	400	2.5	85	0.01	本発明
H 3	550	350	450	400	2.6	84	0.01	本発明
H 4	600	20	450	400	2.7	83	0.01	本発明
H 5	850	10	450	400	2.0	89	0.01	比較例
I	—	—	450	400	1.0	92	0.01	比較例

[0019]

[Effect of the Invention] The raw material for aperture grills of Claim 1 consists Cu of a low carbon steel plate contained 0.05 to 2.5weight %, and the raw material for aperture grills of Claim 2, It has the magnetic properties and intensity which were excellent since Cu was consisted of a low carbon steel plate contained 0.001 to 0.4weight % in 0.05 to 2.5 weight %, and P. After the manufacturing method of Claim 3 cold-rolls the low carbon hot-rolled steel strip in coil which contains Cu 0.05 to 2.5weight %, aging treatment of it is carried out at the temperature of 300-700 **.

After the manufacturing method of Claim 4 cold-rolls the low carbon hot-rolled steel strip in coil

which contains 0.05 to 2.5 weight %, and P for Cu 0.001 to 0.4weight %, At the temperature of 300-700 **, carry out aging treatment and the manufacturing method of Claim 5, The low carbon hot-rolled steel strip in coil which contains Cu 0.05 to 2.5weight % is cold-rolled, Subsequently, after giving intermediate annealing at the temperature of 500-800 **, cold-roll secondarily, carry out aging treatment at the temperature of 300-700 ** after that, and the manufacturing method of Claim 6, The low carbon hot-rolled steel strip in coil which contains 0.05 to 2.5 weight % and P for Cu 0.001 to 0.4weight % is cold-rolled, Subsequently, since it cold-rolls secondarily after giving intermediate annealing at the temperature of 500-800 **, and aging treatment is carried out at the temperature of 300-700 ** after that, The raw material for the aperture grills for color picture tubes which has the magnetic properties which have the outstanding tensile strength and the outstanding high temperature creep strength, and were excellent with these manufacturing methods can be manufactured.

And as for the aperture grill or television picture tube of Claims 7-10, even if heat treatment for [which carries out back melanism] having been welded to the frame is performed, each tape which constitutes the aperture grill does not slacken.

[Translation done.]